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MANUFACTURE OF BOOTS AND SHOES.

By GEORGE A. RICH.

XVI. DEVELOPMENT OF AMERICAN INDUSTRIES SINCE COLUMBUS.

WITH all the uses to which leather is put, that of making boots and shoes is the most important, and calls for the greater part of the product of the tanneries of the country. It is not only the most important in point of magnitude, but it is one which has opened an unusual field for American ingenuity and invention. When the late Charles Stewart Parnell was in this country some years ago, he expressed a desire to see what could be done in an American shoe-factory. Accordingly, what is known to the trade as a Polish lace boot was selected by the Lynn manufacturer, whose building Mr. Parnell was inspecting, as the pattern to illustrate the processes of the art and the speed of the work. Mr. Parnell hastened from one part of the factory to another as the boot in its evolution flew hither and thither, and within twenty minutes after he had seen the pattern placed upon the leather the finished article was handed to him. That, of course, was an exhibition not practicable in ordinary, every-day work. But, compared with the time it would have required to make the boot by hand, it points to the saving that has been effected through the introduction of machinery and emphasizes the mechanical and economical development of the industry. As in the case of tanning, these advances are of comparatively recent origin, dating largely from the civil war and the scarcity of labor consequent upon it. But, though brief the time, the advance from the shoemaker of forty years ago with his hammer and lapstone, to the factory of the present day with its multiplicity of machines and its hundreds of operatives, has been a wonderful one. Indeed, within that period is crowded more in the way of progress and development than is to be found in all the centuries which intervene between the time of the Egyptian cobbler and that of our grandfathers.

There is no article of dress in which more striking changes have been made in the various ages than in the covering for the feet. Until the law was invoked, boots and shoes seemed to be the special field in which the whims of fashion manifested themselves. Coverings for the feet must have been among the earliest articles of dress. It is almost impossible to conceive of a time when ever-recurring injuries from contact with the earth's surface did not suggest some such protection. The primitive form of foot-covering was the sandal, which was simply a flat sole under the foot and secured to it by a thong. These were made of a great variety

of materials. The Egyptians used palm leaves and leather, while the Hebrews preferred linen or even wood. Brass and iron were not found objectionable by some, and in a few instances gold was employed for that purpose. Like the sandal, the shoe grew out of physical conditions, the fundamental purpose of it being protection for the whole foot. Among the early Greeks and Romans shoes were not common, but the wearing of them once established, an endless variety arose—law and fashion dictating special styles and finish for the several social ranks and classes. A single hide, slit and looped into a purse-like pouch by a thong run through it, seems to have been the primitive form of the shoe in Great Britain. Boots and shoes became common in Europe between the ninth and sixteenth centuries, and the fantastic forms which they assumed,

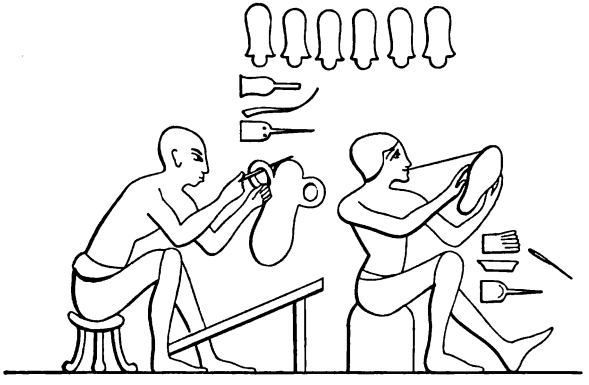

FIG. 1.—ANCIENT EGYPTIAN COBBLERS AT WORK. The familiar awl, lapstone, and thread appear in this. Even the method of drawing the thread is not unknown to those who have ever frequented an old New England cobbler's shop.

and the laws in restraint of them, show the prominent place they had come to occupy in the wardrobe and fashions of the day.

It was not to be expected that there would be a serious demand on the part of the early settlers in this country for these more fashionable styles of boots and shoes. Those who could afford to do so brought with them such articles for holiday and Sunday use, just as they did their velvet breeches and brocade gowns and bits of old lace. But there was a need from the first for stout boots and shoes, both as a protection against the cold and against injury on the rocks and rough soil. Some of the settlers were quick to adopt the moccasin of the Indian; but, though warm and easy to make, it did not meet the ideas of the Europeans. Accordingly, the shoemakers were among the first craftsmen to settle here, and from the privileges that were accorded them from the start their number and influence may be inferred. The early records of Virginia, New York, Pennsylvania, and Massachusetts all bear evidence to their presence and to the establishment of their trade.

But it was in the last State, at Lynn, that the industry had its real origin and center in this country.

Philip Kertland was the first person of that craft to locate in what was to develop into the "City of Shoes," coming thither from Sherrington in Buckinghamshire, England, in 1638. He was joined soon after by Edmund Bridges, and considerable of a local business sprang up. At that time shoemakers went around from house to house and worked up the family stock of leather, but this itinerant system was soon dropped by the Lynn craftsmen as their business grew into more than a local one. The art of shoemaking, however, was not understood and the workmen were unskilled. Occasionally some of the more ambitious ones would send to England for shoes and take them apart, with a view of learning the way of making them. But men who had money and were in a

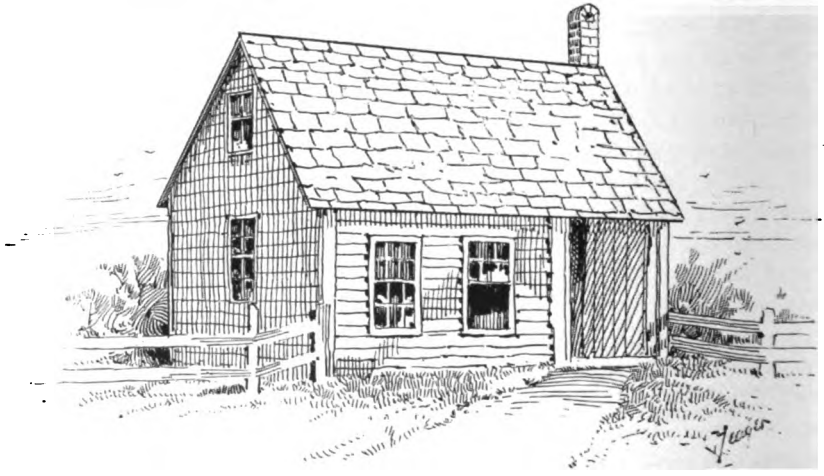

FIG. 2.—AN EARLY LYNN SHOE-SHOP. These shops marked the intermediate stage in the evolution of the shoe industry. With the introduction of machinery, between 1860 and 1870 they passed out of use and largely out of existence.

position to help on such experiments were shy of the shoe business. They preferred to invest in trade and real estate. The result was that no real progress was made in the business until John Adams Dagyr, a Welsh shoemaker, moved to Lynn in 1750. Dagyr was skilled in the methods employed in England, and he proceeded to instruct all who came to him in the art. His fame spread abroad through northeastern Massachusetts, and it was only a short time after his settlement before a notable improvement became apparent in the Lynn product. The Boston Gazette of October 21, 1764, said: "It is certain that women's shoes, made at Lynn, do now exceed those usually imported, in strength and beauty, but not in price." Edward Johnson, of Woburn, in his "Wonder-working Providence," says of Lynn: "All other trades have fallen into

their ranks and places, to their great advantage, especially coopers and shoemakers, who had either of them a corporation granted, enriching themselves by their trades very much. As for tanners

FIG. 3.—A FACTORY OF TO-DAY.

and shoemakers, it being naturalized into their occupations to have a higher reach in managing these manufactures than other men

in New England are, having not changed their nature in this, between them both they have kept men to their stand hitherto, almost doubling the price of their commodities, according to the rate they were sold in England, and yet the plenty of leather is beyond what they had there, counting the number of the people. But the transportation of boots and shoes into foreign parts hath vented all, however."

Inasmuch as this was written only a year after Dagyr's arrival at Lynn, it is pretty safe to set Mr. Johnson down as something of an optimist. But it points to the immediate impetus the industry received under the latter's hand. Yet, by a strange irony, Dagyr, who did so much to establish the shoemaker's art in this country,

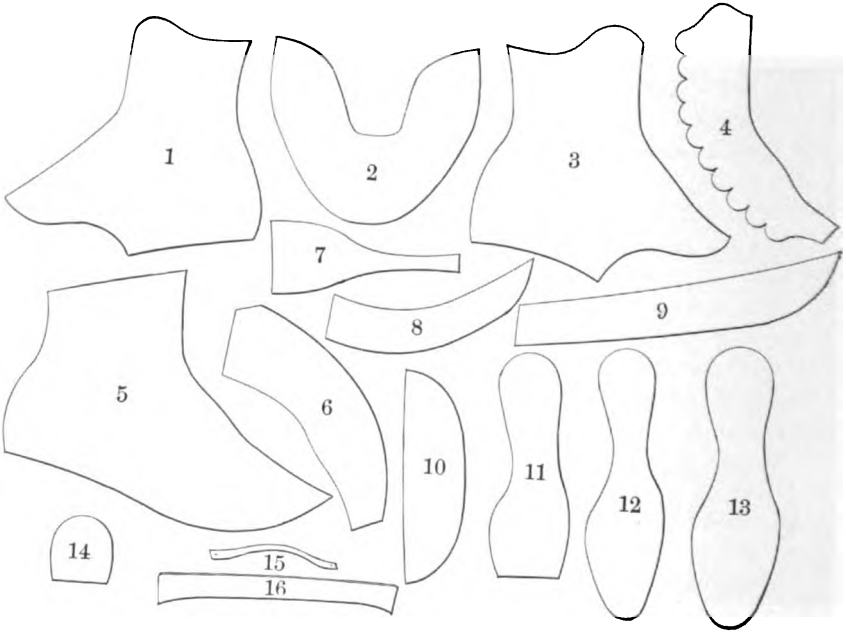

FIG. 4.—PARTS OF A BUTTON SHOE. 1, Large quarter; 2, vamp; 3, small quarter; 4, button piece; 5, drill lining; 6, glove button-piece lining; 7, heel lining stay; 8, button stay; 9, top stay; 10, heel stiffener; 11, sole lining; 12, inner sole; 13, outer sole; 14, heel lifts (six); 15, steel shank; 16, rand.

died in the Essex County almshouse. The principal part of the work at that time was done in little, one-story shops. The rooms were scarcely more than a dozen feet square, with windows at sides and end and a broad fireplace in one corner. They were good-natured, industrious, thrifty companies that filled those shops. Fishermen and farmers and those trained "to the last" were all represented. Journeyman and apprentice, master and workman, stood on the same footing and shared alike. These shops stand, economically and mechanically, between the home and the factory. Shoes were

still sent to the houses of the farmers to be finished, and some of the shops turned out work enough to entitle them to the more ambitious name which is attached to such establishments at the present day. Other towns about Lynn followed its lead; and Marblehead, Danvers, and Haverhill soon became actively engaged in the industry. Women's shoes were then—as they have ever continued—the staple article of manufacture at Lynn. These were made largely of stuff, the finer qualities with white and russet rands, stitched firmly with white waxed thread, pointed at the toes, and adorned with wooden heels covered with leather.

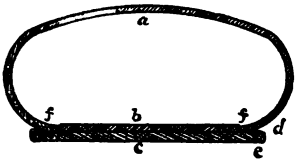

FIG. 5.—SECTION OF A MAN'S BOOT. *a*, The upper; *b*, in-sole; *c*, outsole; *d*, welt; *e*, the stitching of the sole to the welt; *f*, the stitching of the upper to the welt.

That England felt this growing industry of the colonies is shown by the fact that a commission was appointed to inquire into the reason why no more boots and shoes were exported to America. It was with astonishment that the gentlemen composing the commission reported to their colleagues that the colonists were supplying their own foot-wear, and apparently, too, with satisfaction to those concerned. Then came England's desperate efforts to force the trade of the colonies into British channels and the consequent resistance of the latter to such coercion. Under the influence of the import duties, the shoe industry flourished especially, and at the time of the Revolution the manufacturers were unable to meet the demands which were made upon them for boots for the Continental army. But following that came a serious check. The American markets were flooded with English goods, and trade was paralyzed. A demand was then made on the part of the shoe manufacturers for some kind of protection, with the result that, in the first Congress, in 1789, a tariff was arranged so as to check importations. Hon. John B. Alley, of Lynn, at a leather-trade dinner in New York in 1859, gave somewhat of a romantic version to that portion of the tariff affecting boots and shoes—a version which possibly is not to be accepted in detail as history, but which is, nevertheless, of interest. He said that this early duty on imported boots and shoes was due largely to the efforts of Ebenezer Breed, a young Lynn shoemaker, who had located in Philadelphia on account of the dull times in his own town, and of his friend Stephen Collins, a native of the same place. By their influence with members of Congress and with Dolly Payne, the young Quakeress, to whom Mr. Madison, then a rising man in public legislation, was at that time paying attention, they got this boon for their home industry. Be that as it may, with the cessation of imports the Massachusetts shoe-shops

began to expand rapidly, and goods were shipped not only to Boston, New York, and Philadelphia, but even to Liverpool. Lynn, in 1788, exported 100,000 pairs of shoes; while, seven years later, the volume of transactions had increased to 300,000 pairs, and there were at that time 200 master workmen and 600 journeymen and apprentices engaged in the making of them.

But, with all this development of trade, boots and shoes continued to be made by hand. Spasmodic attempts were made to abbreviate the processes, but nothing satisfactory resulted from them for many years. Mr. David Knox, writing in a shoe journal of his experiences as a manufacturer, says: "In 1855, the year in which I commenced business, about the only machinery used in shoe manufacturing were the sewing machines to stitch uppers and the machines to strip leather and cut it into soles. Even these were not in general use. Some manufacturers had introduced revolving cutters—in Lynn the Richards and Foster machines, and in Marblehead the Thompson. With the Foster and Thompson machines soles could be cut reasonably quick, but such was the risk of the operator's fingers being chopped off by the erratic movements of the knives that the old Thompson or Ingalls beam was preferred. By very hard work on these machines about fifteen pairs of soles could be cut per minute, while on the modern machines, operated by steam-power, as many as ninety pairs are cut in the same time, and with vastly more accuracy."

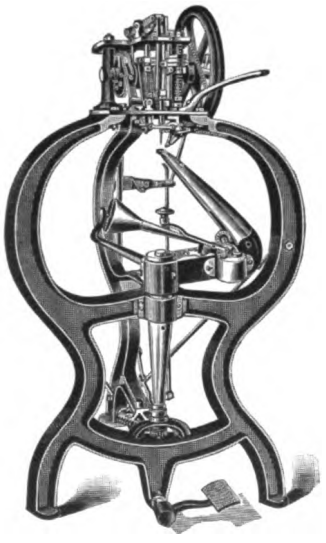

FIG. 6.—McKAY STITCHING MACHINE.

The chief tools of the shoemaker then consisted of his hammer, his awl, his lapstone, his knives, and his harness for "setting-up" his boots or shoes. The essentials of a shoe are the upper, the sole, the counter or heel stiffening, and the heel. These parts are again subdivided into the "vamp" for covering the front of the foot, the large and the small quarters for encircling the ankles, the button-piece, etc. The work of the shoemaker is to prepare and close these various parts of the upper and the linings together, to bring them into the desired shape, to fasten them to the sole which has been previously cut, to attach the heel, and then to give the various parts the desired finish and style. These processes indicate the lines along which machinery had to be applied. All the operations have been subdivided to the minutest detail, and in the performance

of all of them machines—more or less satisfactory in their workings—have been devised. The parts of the uppers are now sewed together by machinery, and they are pegged, sewed, or screwed to the sole by machinery. Instead of the lapstone and the hammer for condensing the leather are now swiftly revolving rollers, and instead of the patterns for cutting out the soles are dies or sole-shaped knives set in machines.

But the field of shoe machinery is such a wide and complex one that it will be impossible to do more than glance at what may be termed the epoch-making inventions. The first great step was made when the sewing machine was invented and the alert manufacturers were able to turn it to their purposes. But the distinction of the sewing machine does not belong to the shoe manufacturers. The invention, however, which did determine their future was that which led to the fastening of the sole of the shoe to the upper by machinery. The solution of this problem had been the real difficulty in the way of applying machinery to the work, and when it had been met the single-story shoe-shop had made way for the factory; its dozen journeymen had lost their individuality in the hundreds of operatives, and the pin-money which the wives of the farmers, or the farmers themselves, had made from the job-work doled out to them by the manufacturers had become a thing of the past. From that dates the shoe industry of to-day. From it also have come the growth and prosperity of important communities in Maine, New Hampshire, and Massachusetts, in New York, Pennsylvania, and the older West. As in the solution of most such problems, it was not hit upon at once. There were failures which were the forerunners of nothing, and failures which were the forerunners of success.

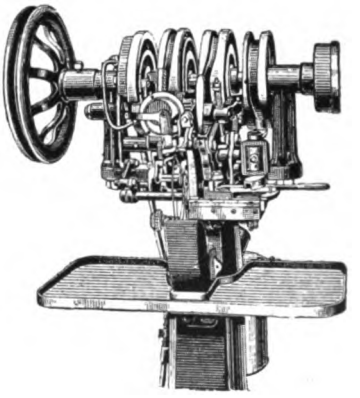

FIG. 7.—GOODYEAR STITCHING MACHINE. This is one of the machines in what is termed the Goodyear welt system.

Two of these latter are worthy of note, as they contained within them the suggestions which, a half-century later, were put into practical operation. The first of these attempts was made in 1809 by David Meade Randolph. He devised a way for fastening the soles and heels to the inner sole by means of nails. His plan was to use lasts covered at the bottoms with metallic plates, so that the nails, when driven through the soles, were clinched on this piece of metal. The next year Mark Isambard Brunel, the eminent engineer, carried this idea a step further. He

FIG. 8.—SCENE IN A STITCHING ROOM.

fastened the soles to the uppers by nails, and, in order to do this, the leather was pressed between clamping plates of the same shape as the sole, the margin of the plate acting as a guide for a knife by which the sole was cut to the desired pattern. This sole was afterward clamped to a last, and there brought under the action of an awl and plunger operated by a lever. The sole-fastenings, usually nails, had to be placed in these awl-holes by hand, and were then driven in by the plunger, the awl at the same time making another hole for the next nail. Devices were also made for spacing the holes and clinching the nails on the inside of the shoe; but the shoes thus made proved unsatisfactory, the nails in them working loose.

In the actual solution of this problem two courses were pursued, the extension of the principle involved in the Randolph and Brunel devices and the application of the principle of the sewing machine. From the development of the one have come the pegged, nailed, and screwed boot and shoe; from the other, the stitched ones. In point of order the pegging machine came before the sole-sewing machine, standing as the invention of A. C. Gallahue, and under the date of 1851. Its operations were essentially the same as those of the cobbler who pierces the hole through the sole of the boot before him with his awl, and then, taking a peg from the generous store with which he has previously filled his mouth, drives it home with his hammer. Joseph Walker, of Hopkinton, Mass., had invented the shoe-peg about 1818, and it had commended itself to the craft at once. Machines were made for the manufacture of the pegs, and so thrifty were some of those engaged in their production that it is said they were sold in certain sections of the country not only as shoe-pegs but as a new kind of oats. Gallahue's machine included a cylinder on which were wound, like the spring of a watch, ribbons of birch of the same width as the length of the peg and sharpened on one edge. These were fed to the machine which, with knife, awl, and plunger, split the strips into widths of a peg, made a hole in the sole, and drove the peg into the shoe jacked beneath. Gallahue's invention was perfected by Messrs. E. Townsend and B. F. Sturtevant, of Boston. This idea has been still further developed in machines for riveting the two parts of the shoe together, the nails being clinched by coming in contact with an iron last, in a way suggestive of Brunel's method, and in machines for screwing them together. The screw machine, which came into use about 1875, is provided with a reel of stout screw-threaded brass wire, and this by the revolution of the reel is inserted into and screwed through the out-sole, upper edge, and in-sole. Within the upper a head presses against the in-sole directly opposite the point of the screw, and, when screw and head touch, the wire is cut level with the out-sole.

The first decisive step in sewing the sole and upper together was taken by Lyman R. Blake in 1858, his machine being perfected as the McKay sole-sewing machine. The machine, as described by Blake in his application for an English patent, "is a chain-stitch sewing machine. The hooked needle works through a rest or supporting surface of the upper part of a long, curved arm which projects upward from the table and the machine. This

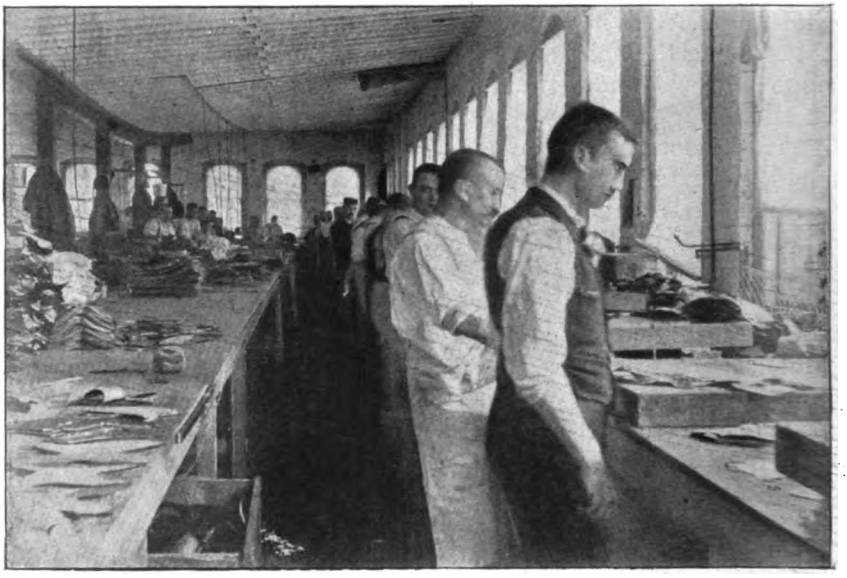

FIG. 9.—THE CUTTING ROOM.

arm should have such a form as to be capable of entering a shoe so as to carry the rest into the toe part as well as any other part of the interior of it. It carries at its front end and directly under the rest a looper, which is supported within the end of the arm so as to be capable of rotating or partially rotating round the needle, while the needle may extend into and through the eye of the looper, such eye being placed in the path of the needle. The thread is led from a bobbin by suitable guides along the curved arm, thence through a tension spring applied to the arm, and thence upward through the notch of the looper. The feed-wheel, by which the shoe is moved along the curved arm during the process of sewing, is supported by a slider extending downward from the block and applied thereto so as to be capable of sliding up and down therein. The shoe is placed on the arm with the sole upward." In less technical language, the machine consists of a combination of wheels so arranged as to drive an awl-like needle through several thicknesses of heavy leather, and feed a waxed thread in any direction. The shoe itself rests upon the end of the

arm or horn noted in the above description, from the interior of which is supplied the waxed thread previously heated by a gas-jet within. But Blake's first machine was very imperfect. A leading interest in the invention, however, happened to fall into the hands of Mr. Gordon McKay. Realizing the importance of the principle, the two set themselves to its improvement. As perfected, they got patents on it in 1860, which gave them the practical control of the machine-made boots in this country for many years. It is said that nearly two hundred thousand dollars were spent on the invention before anything was realized from it. But when the return came it was indeed a golden harvest. None of the machines were sold outright to manufacturers, but they were let to them on the payment of royal-

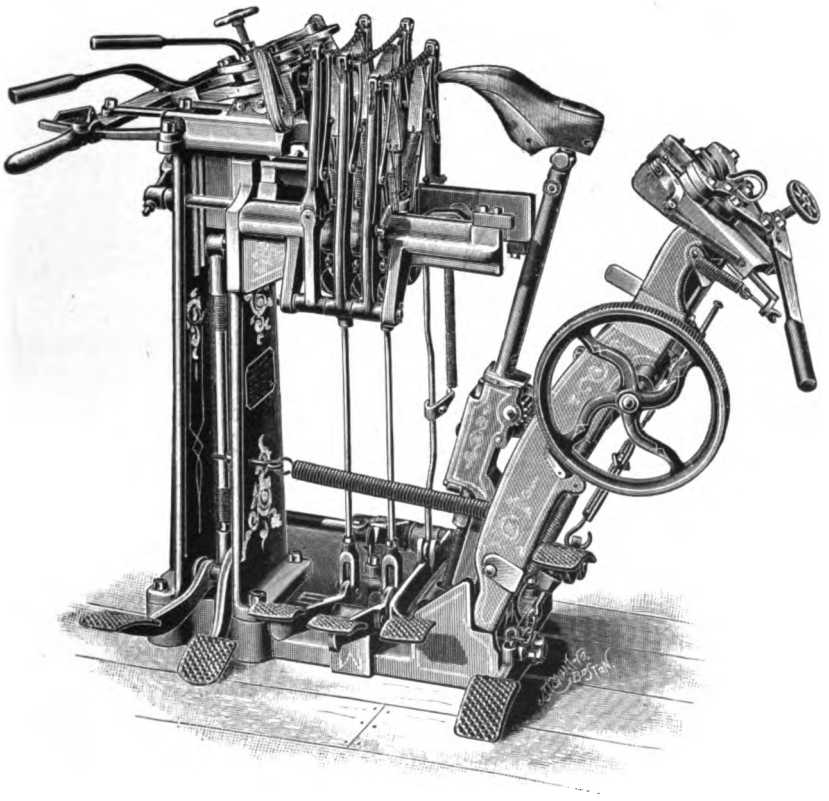

Fig. 10.—Copeland Rapid Laster.

ties; and to show what that amounted to is the fact that one Lynn manufacturer in a single year paid the company fully fifteen thousand dollars for the use of McKay machines in his shop. Under the pressure of the war the demand for boots and shoes of stout quality but cheaper grade was enormous, and it

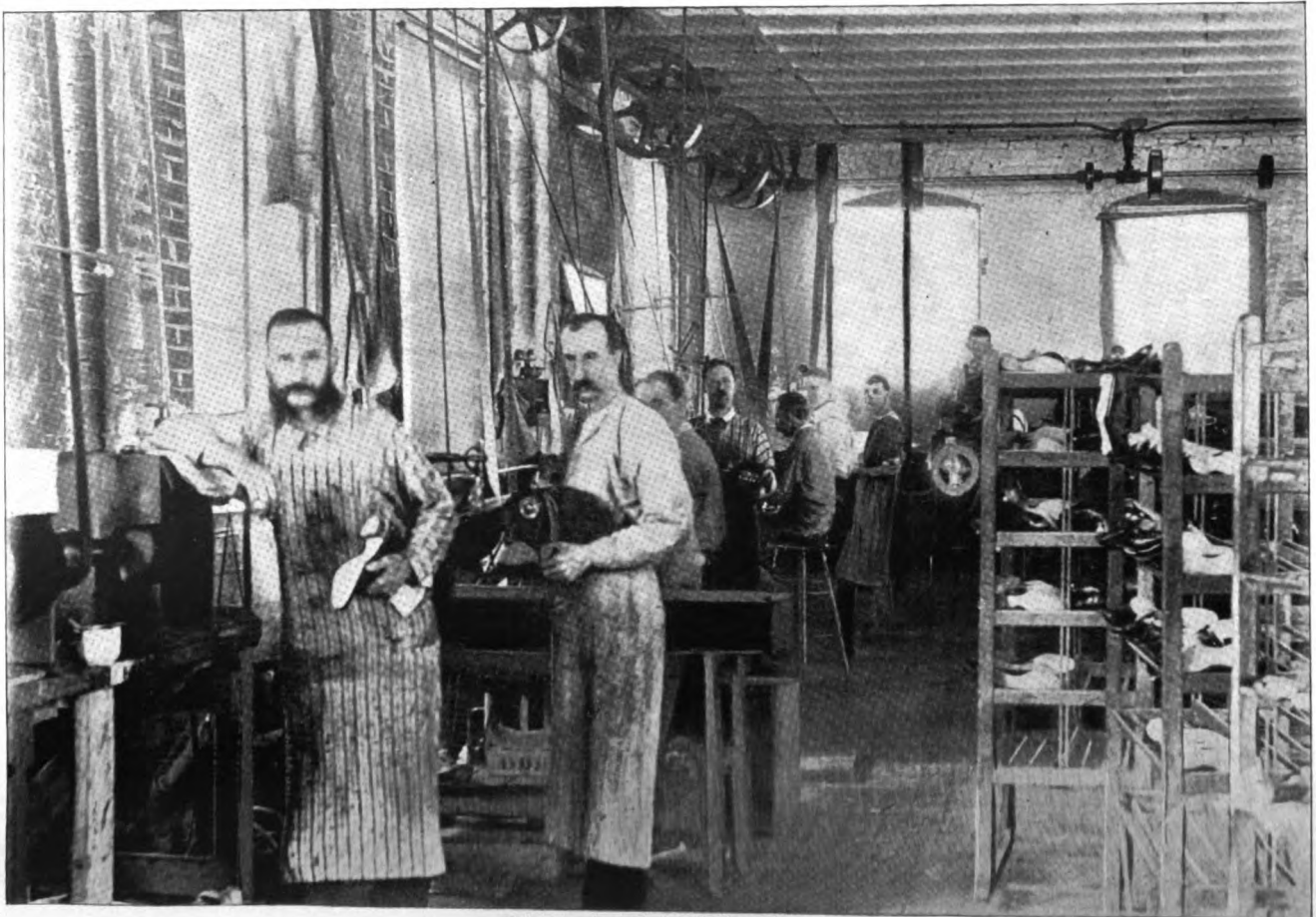

FIG. 11.—PUTTING ON THE HEELS.

was largely to that class of work that the McKay machine was turned.

The close way in which the McKay machine was held tended to check further improvements for a time. The suggestions afforded by it and its success, however, were open to all, and several inventions were later offered to the public. Most important among these were the Goodyear and McKay machines for welted sewing, the first mechanism for stitching the soles on lasted shoes. In Fig. 5, which represents a section of a boot, *a* is the upper, *b* the in-sole, and *c* the out-sole, while *d* is the welt, *e* the stitching of the sole to the welt, and *f* the stitching of the upper to the same. Following the process of lasting—that is, after the upper has been carefully drawn over the last—the welt is put in position around the sides up to the heel. The thin edge of this is then caught together with the upper and inner sole. The outsole is afterward tacked to the insole and, through a narrow channel made around the edges of it, sewed to the welt. The difficulties in the way of getting a machine which would do this, not simply as well as the hand, but do it at all, were many. The method which finally succeeded originated in a patent secured in 1862, by August Destory, for a curved-needle machine for sewing out-soles to the welts; but the machine did not work satisfactorily until it was taken in hand by Charles Goodyear, the son of the inventor of the India-rubber processes. This machine simply transforms the swinging movements of the hand and forearm in sewing into lateral and vertical ones, but the principle in the two operations is identical. There is one difference which in a way may be said to be even a point in favor of the machine sewing. In hand sewing the thread is drawn clear through its full length each time, and thus is weakened by constant wear. In the machine, only so much is drawn through as is necessary to form the stitch. These machines have been perfected and multiplied until what is known as the Goodyear system is the result. This system includes machines for sewing the welt on, attaching the sole to the upper, for lasting the upper, for

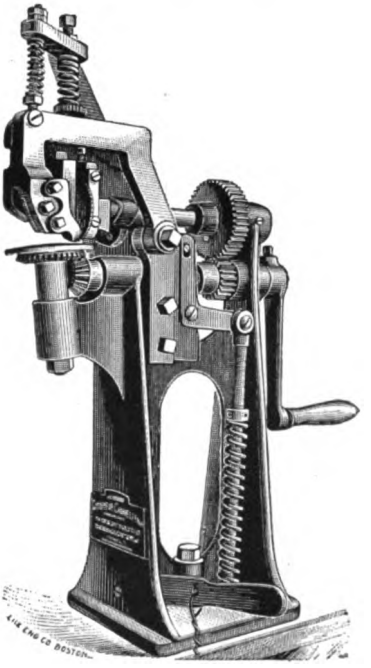

Fig. 12.—In-sole Channeler.

channeling or making the groove in which the stitching uniting the sole and upper runs, and for sewing turned shoes or work in which there is only one flexible sole attached to the upper, and done with the outside turned in.

Lasting has been the most difficult of all the operations from which machinery has attempted to rout hand-work. The work of the laster is to pull the upper tightly over a last, adjust to it the inner sole, insert the counter-shank, and fasten the upper in place. He also applies the outer sole to the upper, but does nothing further. Now, the irregular shape of the upper, requiring looseness at one point, stretching here and pinching there, in order to shape it to the last, makes it exceedingly hard to secure a machine which will do it with any kind of success. Patents, however, were taken out in England in 1842 for a machine intended to perform this work, and these were issued in this country in 1862. Messrs. McKay and Copeland purchased those rights in 1872, and ten years later was introduced what is known as the Copeland laster, a machine for men's work. The shoe in this machine lies in a kind of matrix, under which are leather girth straps attached to iron fingers. The shoe is held stationary while these fingers move up, inward, and down. The toe and heel are lasted by plates which are mounted on a table that oscillates and adapts its motion to the last. But it is not entirely machine-work, as hand-pincers are used to bring the uppers to the last. For women's and misses' shoes the Boston Lasting Machine Company has a different invention. The shoe in that case is lasted on a jack, the upper being drawn over by pincers, and the shoe itself is afterward brought up to the nozzle of the machine, contact with which starts some automatic tack-driving machinery, and the shoes are fastened as shaped with great rapidity. But manufacturers say that there is much to be accomplished yet before the perfection of hand-work is secured and the fingers and pincers can be entirely dispensed with.

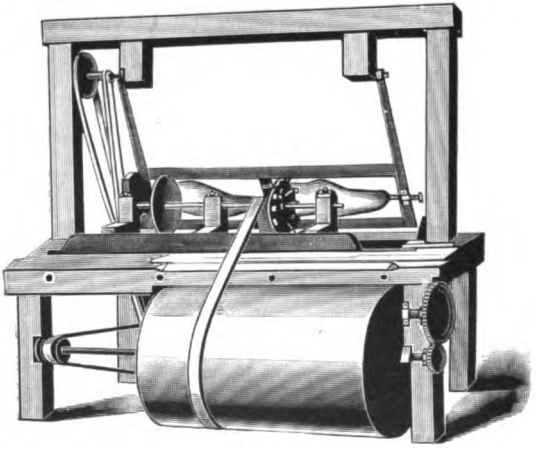

FIG. 13.—FIRST LATHE FOR TURNING LASTS.

The making of these lasts is a considerable industry in itself. Each manufacturer carries a stock of from two thousand to four

thousand of them, and they have to be changed with every variation in the style. Originally shoe-lasts were whittled out of rough blocks of wood by hand, but in 1815 Thomas Blanchard, well known in his day as an inventor, devised a lathe for turning them out by a less laborious process. A pattern had first to be made, and then this and a block of wood were fixed on the same axis and made to revolve around a common center in a swinging lathe by a pulley and belt on one end of the axis. The cutting wheel turned on a horizontal axis, and to it were attached a number of irregular cutters which acted like gouges when the wheel was set in motion. This wheel was placed opposite the block, while opposite the pattern was a friction-wheel of the same size. By the combined movements of this axis and a sliding carriage the irregular surface of the pattern caused the axis on which the friction-wheel was to alternately approach and recede, and this motion was in turn communicated to the knife-wheel. The result was that a duplicate of the pattern was produced from the block of wood. The last lathe has been improved since in many ways, but they are all based on the principles introduced by Blanchard.

It is impossible to more than name some of the other machines which have been introduced and which have done much to hasten the manufacture and reduce the cost of foot-wear. The sole-die machine was introduced about 1851, operated first by foot-power and later by steam. The buffing machine, a sanded cylinder for the purpose of giving a velvety finish or "nap" to the bottom of the sole, followed in 1855, and the eyeleting machine in 1864. Other machines of more recent date are the beating-out machine, between the forms of which the sole of the shoe, after the channel groove has been filled with naphtha cement, is subjected to enormous pressure; the trimming machine, whose revolving knives remove the rough edges of the sole; the burnishing machine, and the heeling machinery. It can not but be a source of gratification to Americans that the most of these inventions have had their origin on this side of the ocean, and that those that did not so originate have received their greatest development here. The experiments in England with the sewing and nailing machines had not enough success to warrant any serious claim to the invention. The American shoe-factory is the triumph of American ingenuity. There is no better word than "ingenuity" to describe it. It stands for the discovery of no new principle in mechanics. It represents the utilization of no new force in Nature. But it does contain within it some of the most remarkable adaptations of mechanical principles already known and the most marvelous devices for supplanting the work of the fingers. A modern shoe-factory would make a fitting monument for the Patent Office.

To realize how the introduction of machinery into the tanning

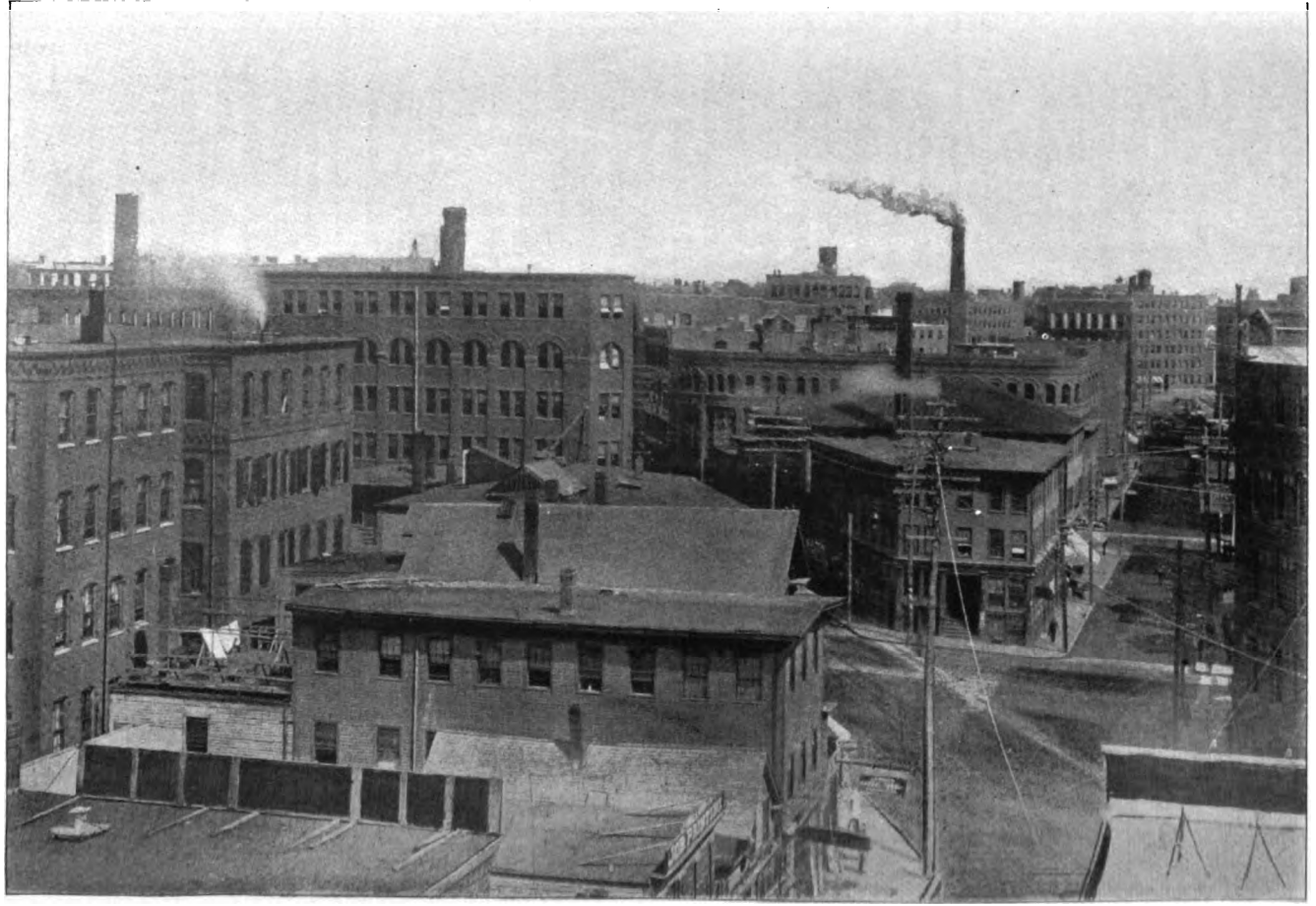

FIG. 11.—A GLIMPSE OF THE "CITY OF SHOES."

and shoemaking industries has cheapened the products of the latter, one has only to compare the price of any kind of goods for a series of years. For illustration, take women's Polish grain shoes, men's boots and brogans. These are all cheap goods, and as the prices in the first place would have to be as low as possible great reductions would not be expected. Yet note:

Ladies Polish shoes per pair: 1865, $2.25; 1868, $1.62½; 1870, $1.37½; 1875, $1.12½; 1880, $0.95. Brogans: 1865, $1.75; 1870, $1.50; 1880, $1.30; 1885, $1.20; 1890, $1.05. Men's heavy boots, per dozen pairs, kip and double half soles in order: 1872, $38 and $25; 1880, $26 and $21.50; 1885, $26 and $20; 1890, $21 and $17.

In spite of all competition Massachusetts has retained its early grip upon the shoe industry, and within its factories are to be seen the art at its highest and its results at their best. In 1845, in that State, 45,877 hands made 20,896,312 pairs of boots and shoes, and in 1875 49,608 made 59,762,866 pairs—that is, an increase of less than one tenth in the manual force resulted in an output nearly three times as great. New Hampshire and Maine, however, have considerable interests in the shoe business, and factories are beginning to spring up in the West and the South. Unfortunately, the census figures for the last decade have not been completed; but the following table will tell the story for the thirty years between 1850 and 1880:

	1850.	1860.	1870.*	1880.
Whole number of establishments	11,305	12,487	† 3,151 23,428	† 1,959 17,972
Persons employed	105,254	123,029	91,702 135,889	111,152 133,819
Capital	$12,924,919	$23,358,527	$37,519,019 $48,994,366	$42,994,028 $50,995,144
Wages	$21,622,608	$30,938,920	$42,504,444 $51,972,712	$43,001,438 $54,358,301
Materials used	$23,848,374	$42,729,649	$80,502,718 $93,582,528	$102,442,442 $114,966,575
Value of product	$53,967,408	$91,891,498	$146,704,055 $181,644,090	$166,050,354 $196,920,481
Wages per employé	$205 43	$251 48	$463 50 $382 46	$387 21 $381 07

The increase in the number of establishments between 1860 and 1870 and the decrease between 1870 and 1880 mean no decline in the industry. This change results from the tendency toward consolidation and concentration. Improved machinery has enabled large producers to crowd their smaller competitors out of the business or to force them into combination. The same move-

* Currency.

† The first figures in these columns are special factory statistics. These were collected only in 1870 and 1880.

ment is manifest in other manufacturing industries, like cotton and woolen. The decade following the war was a period of enormous individual expansion, while that succeeding it was one of corporate extension. This fact appears in the marked increase in capital and productive capacity in union with a decrease in the number of separate factories. That the forthcoming census will show further evidences of this change seems certain from the reports that have been published from time to time during the past ten years by those familiar with the progress of the industry. This development, however, has not been at the expense of the operatives, as is shown by the increase in their earnings since the introduction of machinery. The gain has been more than a third, as indicated by the above table. In 1885 the Massachusetts Bureau of Statistics of Labor undertook an investigation of the net profits of the manufacturing industries of the State, and from returns received from 2,344 private boot and shoe manufacturing firms, employing 66,800 operatives, the average yearly earnings of the latter were $385.89; and from 22 corporations, employing 2,731 operatives, the average was $417.06. That would give for the 2,366 concerns annual average earnings of $401.47 for the operatives, considerably in excess of the country at large. The same investigation showed that in the cost of the production of boots and shoes 27·65 per cent was charged to labor and in that of leather 17·07 per cent went to it. This compares with 28·84 in cotton goods, 20·72 in woolen goods, and 27·18 in silk goods. On the side of the manufacturer these returns showed a net profit of 14·06 per cent on the capital invested in the boot and shoe industry against 8·13 per cent in leather, 0·65 in cotton goods, and 5·47 in woolen goods. The American shoe operatives as a body are thrifty and prosperous, and certainly much better paid than their fellow-craftsmen abroad. Skilled operatives in this country earn from $11 to $18 a week, while the same class in England obtain only $5.50 to $8.50, and in Germany $5 to $6.50. Mr. W. L. Terhune, of the Boot and Shoe Recorder, in an account of a trip among the shoe-factories of England, says that the skilled operatives at Northampton told him that they averaged only about $6 a week, so that the annual earnings for the best paid of them scarcely exceeded $300. With the extension, or rather the over-extension, of the business, and the consequent competition, there have come cuts in wages and strikes; but the same leaven of unrest prevails in the other old industries, and there is nothing peculiar about its manifestation, perhaps, except that the operatives and manufacturers in the shoe industry are both better organized than in other branches.

What the next decade has in store for the boot and shoe industry can be only a matter of speculation. At present the machines

for the several operations are distinct. Will some genius combine them into a single one? Will it be possible ever to throw into a hopper a side of leather and take out a finished shoe? Such a question appears absurd to-day. But what would our great-grandfathers have thought of the McKay or Goodyear stitchers?

BEGINNINGS IN BOTANY.

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MUCH has been said, largely in a theoretical way, concerning the general question of university extension. Various experiments have been made, and by another year definite plans will be matured for the popular presentation of many of the subjects that come within the scope of the extension movement as now understood by those who have had the most to do with the scheme for the education of the masses.

The writer has recently finished a brief course in botany, and, as the method pursued differed in some features from any previously followed, there may be sufficient reason, in this, for presenting an outline of the ground covered and the ways and means employed for bringing the subject to the attention of a popular audience.

The course consisted of six meetings, and the average attendance was fifty. Each session extended over two hours, namely, from four until six in the afternoon of successive Fridays for six weeks in late spring. The first hour of each exercise was devoted to a lecture, and the following were the subjects considered: (1) The Seed, its Origin, Structure, and Uses; (2) the Stem and Root; (3) the Leaf, its Structure and Function; (4) the Flower, its Form and Use; (5) the Fruit—Kinds and Functions; (6) Ferns, Mosses, Algæ, and Fungi.

A full outline of these lectures was furnished each pupil in a sixteen-page syllabus, and the points covered were fully illustrated by means of *papier-maché* models of various sorts of plants, by numerous wall-charts, and, best of all, by a large number of living specimens.

The lecture served as an introduction to the class exercise which it immediately preceded. In this latter each pupil was furnished with a seat at a table and provided with specimens upon which to work. As before stated, the first lecture was upon seeds. This embraced the whole question of germination, and for a portion of the class-hour attention was given to the study of seedling plants, each pupil having specimens of young corn